APPENDIX

C

Performance Measures

TABLE OF CONTENTS

PERFORMANCE MEASURES

Introduction

This section documents the efforts undertaken by SCAG, its staff and consultants, and the Technical Advisory Committee related to the 2004 RTP Goals and associated performance measures leading up to the evaluation of the RTP Plan performance.

The development of theses goals and performance measures took place over 10 months beginning in May 2002. The study team under the direction of the 2004 RTP Technical Advisory Committee (TAC) revised the goals and associated performance measures for the RTP Update. The SCAG Transportation and Communications Committee (TCC) approved the goals and objectives. The Regional Council adopted the goals in December 2002 and adopted the performance measures in March 2003.

Exhibit C.1 lists the adopted goals for the 2004 RTP Update. It also shows the goals used in the 2001 RTP. One of the major changes in the goals between the two RTPs is that the 2004 goals were simplified to be easier to understand, and to make the linkage between the goals and the performances more transparent.

Exhibit C.2 shows the linkage between the goals and the performance measures.

Exhibit C.3 defines each of the performance measures, presents benchmarks for performance, and identifies how each is to be calculated. These measures were reviewed at length by the TAC and were designed to meet the following criteria as closely as possible:

- modally blind
- measurable - for both monitoring and forecasting to the extent possible
- consistent with sub-regional and state-wide indicators where possible
- linked to revised RTP goals

These measures were then used to evaluate a number of scenarios, including the RTP, the two PILUT scenarios, and the 2001 RTP Modified scenario which reflects the 2001 RTP projects updated as appropriate by the county and sub-regional agencies.

Exhibit C.1: 2001 and 2004 Adopted RTP Regional Goals

2001 RTP	2004 RTP
Improve transportation mobility for all people and enhance the movement of goods within the subregions and the Region.	Maximize mobility and accessibility for all people and goods in the region
Ensure that transportation investments are cost-effective, protect the environment (including improving air quality), promote energy efficiency and enhance the quality of life.	Ensure travel safety and reliability for all people and goods in the region
Serve the public's transportation needs in safe, reliable and economical ways that also meet the individual needs of those who depend on public transit, such as the elderly, handicapped and disadvantaged.	Preserve and ensure a sustainable regional transportation system
Develop regional transportation solutions that complement the subregional transportation systems and the land-use plans of communities within the subregions.	Maximize the productivity of our transportation system
Promote transportation strategies that are innovative and market-based, encourage new technologies and support the Southern California economy.	Protect the environment, improve air quality and promote energy efficiency
Encourage land-use and growth patterns that enhance the livability of our communities and maximize the productivity of our transportation investments.	Encourage land use and growth patterns that complement our transportation investments

Exhibit C.2: 2004 Adopted RTP Regional Goals and Performance Measures

RTP Goals	*RTP Performance Measures*								
	Mobility	Accessibility	Cost Effectiveness	Reliability	Productivity	Safety	Preservation	Sustainability	Environmental
Maximize mobility and accessibility for all people and goods in the region	✓	✓	✓						
Ensure travel safety and reliability for all people and goods in the region	✓			✓		✓			
Preserve and ensure a sustainable regional transportation system							✓	✓	
Maximize the productivity of our transportation system	✓				✓				
Protect the environment, improve air quality and promote energy efficiency									✓
Encourage land use and growth patterns that complement our transportation investments	✓	✓							✓

Exhibit C.3: 2004 Adopted RTP Performance Measure Definitions

Performance Measure	Measure(s)	Definition	Performance Target	Calculation Data Sources
Mobility	• Speed • Delay	Speed - experienced by travelers regardless of mode Delay – excess travel time resulting from the difference between a reference speed and actual speed Delay per capita can be used as a supplemental measure to account for population growth impacts on delay.	Improvement over base year	• Travel demand model outputs o AM peak, PM peak, Off-peak, Daily o Link speeds, travel times, trips
Accessibility	• % PM peak period work trips within 45 minutes of home • Distribution of work trip travel times		Improvement over base year	• Travel demand model outputs o PM peak o OD travel times o OD person trips
Reliability	• % variation in travel time	Day-to-day change in travel times experienced by travelers. Variability results from accidents, weather, road closures, system problems and other non-recurrent conditions	Improvement over base year	• Highways – PeMS • Transit - National Transit Database or triennial audit reports
Safety	• Accident rates	Measured in accidents per million vehicle miles by mode for: o Injury o Property	"0" for all accident types and modes	• Highways - freeway accident rates from Caltrans • Transit - National Transit Database or triennial audit reports
Cost Effectiveness	• Benefit to Cost (B/C) Ratio	Ratio of benefits of travel alternatives to the costs of travel including: infrastructure, maintenance, travel time, environmental, accident, and vehicle operating costs. Can be used to evaluate impacts of mode split changes resulting from RTP investments	Improvement over base year	• Travel demand model outputs • Revenue forecasts • RTP project expenditures • Other cost estimates

Performance Measure	Measure(s)	Definition	Performance Target	Calculation Data Sources
Environmental justice	• Distribution of benefits and costs • Accessibility • Environmental o Emissions o Noise	Share of net benefits and costs by mode, household income, race/ethnicity: • RTP expenditures • Taxes paid (e.g., income, sales & use, gas) • Travel time savings by mode • Access to jobs (See "Accessibility") • Environmental impacts from PEIR	Equitable distribution of benefits and costs	• Travel demand model outputs • Revenue forecasts • RTP project expenditures • PEIR
Productivity	• % capacity utilized during peak conditions	Transportation infrastructure capacity and services provided. • Roadway Capacity - vehicles per hour per lane by type of facility • Transit Cap. – seating capacity by mode	Improvement over base year	• Highways - PeMS • Transit - National Transit Database or triennial audit reports
Sustainability	• Total cost per capita to sustain system performance at base year levels	Focus is on overall performance, including infrastructure condition. Preservation measure is a sub-set of sustainability.	Improvement over base year	• Sub-regional submittals • Regional population forecast
Preservation	• Maintenance cost per capita to preserve system at base year conditions	Focus is on infrastructure condition Sub-set of sustainability.	Improvement over base year	• Sub-regional submittals • Regional population forecast
Environmental	• Emissions generated by travel	Measured/forecast emissions include CO, NOX, PM10, SOX, and VOC. CO2 as secondary measure to reflect greenhouse emissions	Meet SIP Emission Budget & Transportation Conformity requirements	• Travel demand model outputs • AQMD Urban AIRSHED Model (UAM)

Plan Performance

This section briefly describes each performance measure and then presents the results of the different scenarios analyzed, which are:

- Base Year (2000) - used to reflect current conditions

- Baseline/No Project (2030) - which represents a future scenario that includes only those transportation projects programmed in the 2002 RTIP that are currently under construction or undergoing right-of-way acquisition, come from the first year of the RTIP or previous RTP, or have completed the National Environmental Policy Act (NEPA) process by December 2002.

- Plan (2030) - which represents the set of transportation projects and policies included in the 2004 RTP, including the associated Plan forecast (Growth Vision) which contains transportation/urban-form strategies that encourage compact growth, increased jobs/housing balance, and centers-based development, where feasible.

- Modified 2001 RTP (2030) - which represents an update of the adopted 2001 RTP to reflect the most recent growth estimates and transportation planning decisions and assumptions. This Alternative does not include urban-form strategies.

- PILUT 1/Infill (2030) - which includes transportation investments and land use strategies that encourage a substantial portion of future growth to be concentrated in existing urban centers through infill and redevelopment. This alternative has been designed to reduce consumption of open space and habitat.

- PILUT 2/Fifth Ring (2030) - which includes additional transportation investments and land use/transportation strategies that encourage growth toward a more decentralized urban form and an improvement in the jobs/housing balance and in the outlying areas of the region. Specifically, PILUT 2 focuses on improving and expanding infrastructure to efficiently utilize undeveloped land on the outer edges of the urbanized area.

Overall Demand

Population growth expected will lead to higher travel demand in the Region. Population is expected to grow from almost 17 million in year 2000 to almost 23 million by year 2030. These additional 6 million residents will generate more trips for all modes. Overall daily travel trips are expected to rise from 55 million to almost 76 million, an increase of over 37 percent. This type of increase is difficult to mitigate with system expansion alone. The RTP therefore addresses this increased demand using a variety of innovative strategies, including system productivity improvements, privately financed infrastructure projects, and through land use integration policies. The remainder of this section describes the impacts of these strategies on system performance.

Mobility Results

The RTP uses two commonly used mobility measures: speed and delay. Speed is the average speed experienced by travelers regardless of mode in miles per hour (MPH). Delay is the difference between the actual travel time and the travel time at some pre-defined reference or "optimal" speed for each mode alternative under analysis. It is measured in vehicle-hours of delay (VHD), which can then be used to derive person hours of delay.

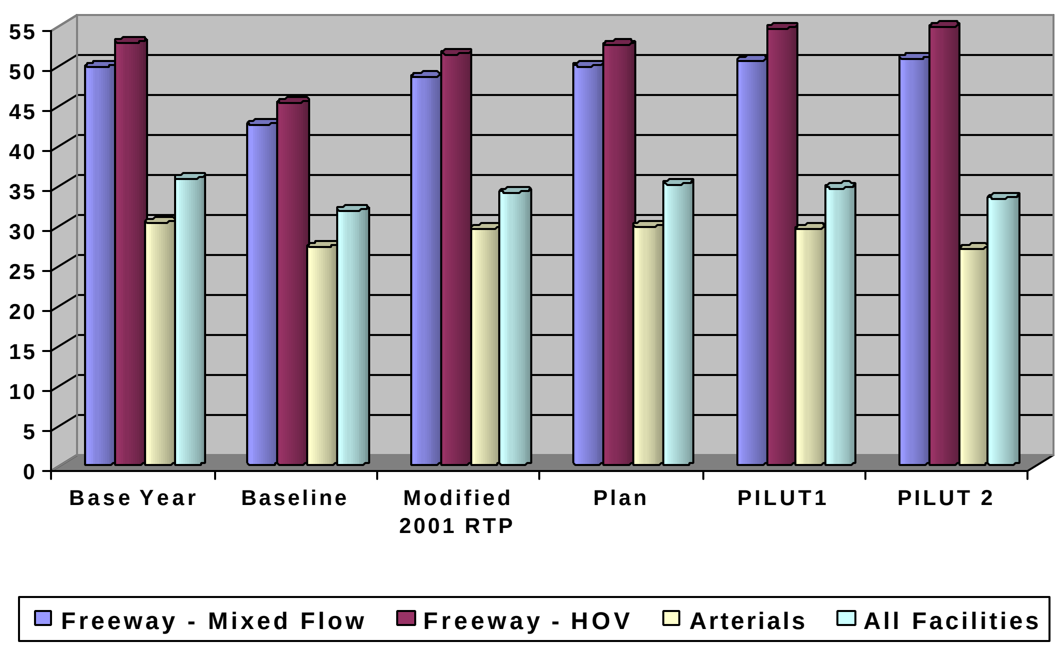
Speed Results

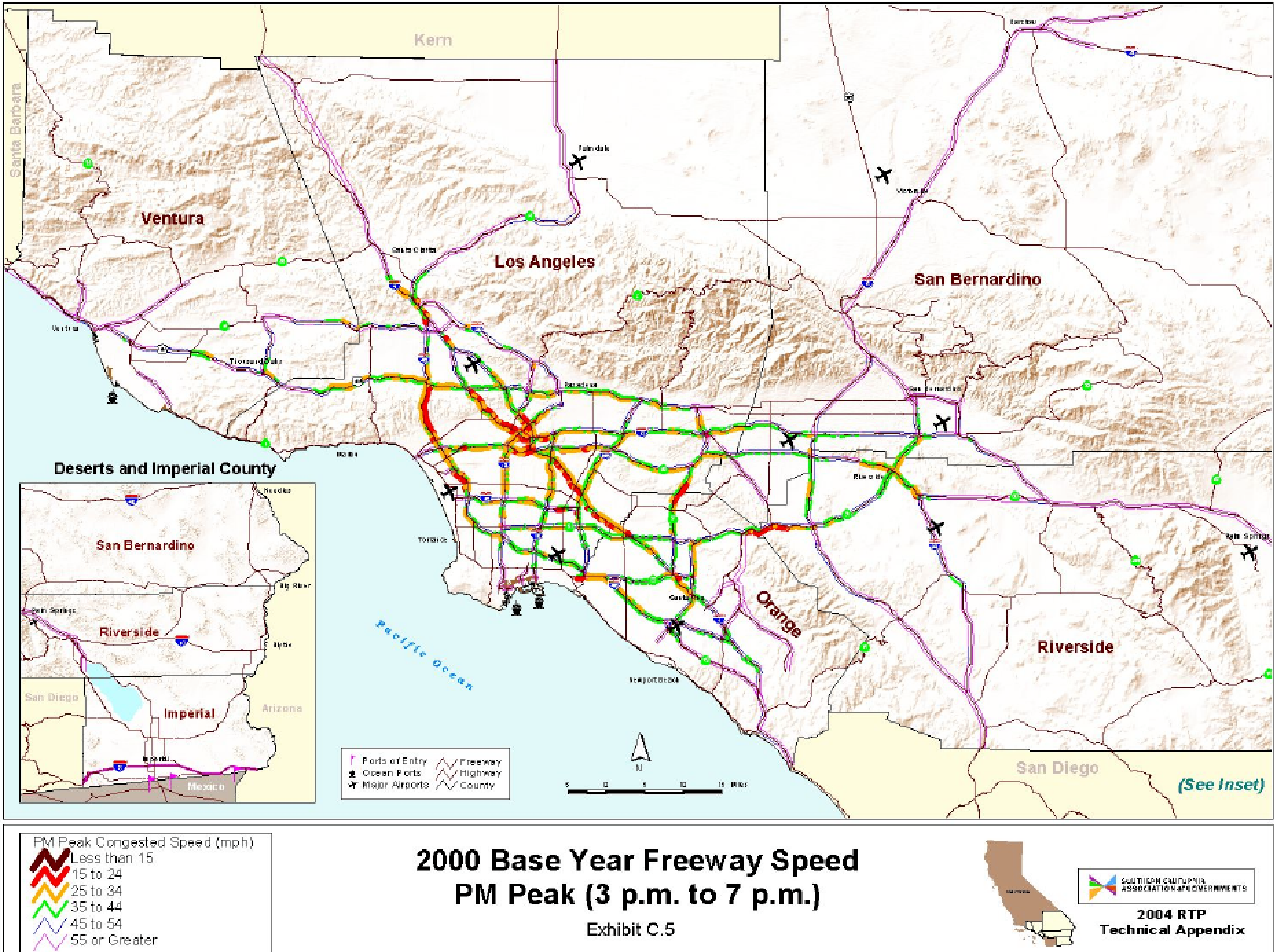
Speed and delay were forecasted using SCAG's travel demand model. Speeds are shown in several exhibits:

- Exhibit C.4 presents average daily speeds by facility type for each scenario used in the evaluation process. Note that the 2030 Plan speeds are only 0.7 miles per hour lower than the 2000 Base Year (from 35.9 to 35.2 miles per hour), which is impressive given the growth in demand expected through 2030.

- Exhibit C.5 through C.7 depict the PM peak freeway speed information on a regional map for 2000 Base Year, 2030 Baseline and 2030 Plan.

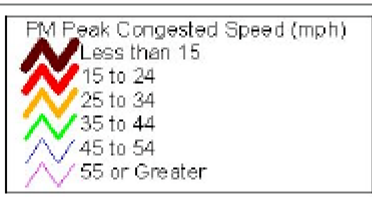
Exhibit C.4: Scenario Average Daily Speeds by Facility





2000 Base Year Freeway Speed
PM Peak (3 p.m. to 7 p.m.)

Exhibit C.5

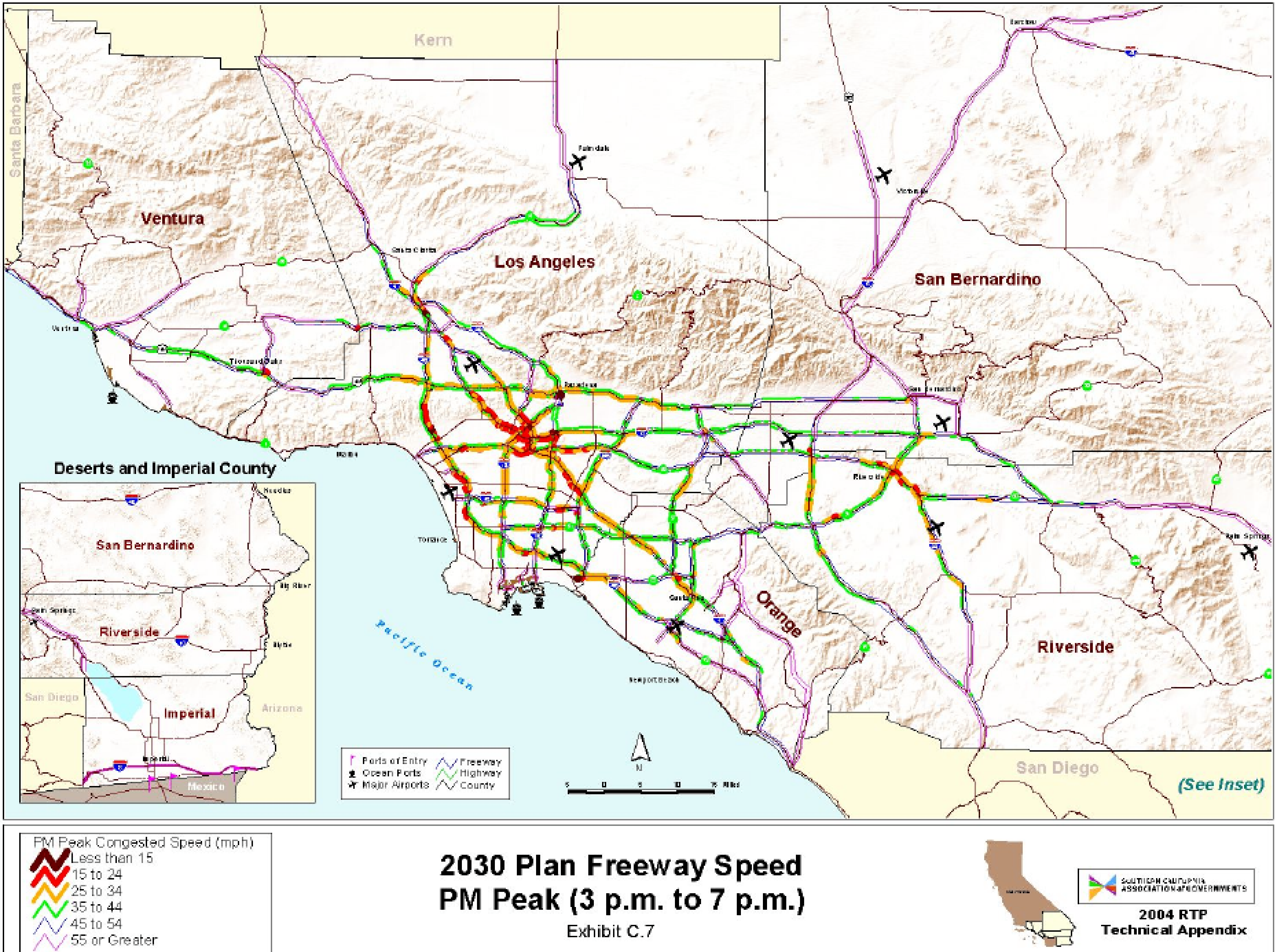


2030 Baseline (No Project) Freeway Speed PM Peak (3 p.m. to 7 p.m.)

Exhibit C.6

SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

2004 RTP Technical Appendix



2030 Plan Freeway Speed
PM Peak (3 p.m. to 7 p.m.)

Exhibit C.7

2004 RTP
Technical Appendix

<u>Delay Results</u>

Delay is also calculated using SCAG's travel demand model. Vehicle-Hours of Delay are calculated by the following formula:

$$([\text{Actual Travel Time}] - [\text{Travel Time at Reference Speed}]) \times \text{Volume}$$

or

$$\left(\frac{[\text{Distance}]}{[\text{Actual Speed}]} - \frac{[\text{Distance}]}{[\text{Reference Speed}]}\right) \times \text{Volume}$$

Exhibit C.8 presents highway scenario average daily vehicle-hours and person hours of delay. Note that the Plan reduces vehicle delays from an average of 3.8 million hours per day in the Baseline to 2.2 million hours of delay. However, the total is still approximately 0.7 million hours more than current Base Year 2000 vehicle delay. Person hours of delay are computed by multiplying vehicle hours of delay by the average vehicle occupancy estimates for each scenario.

Exhibit C.8: Scenario Average Daily Vehicle and Person Hours of Delay

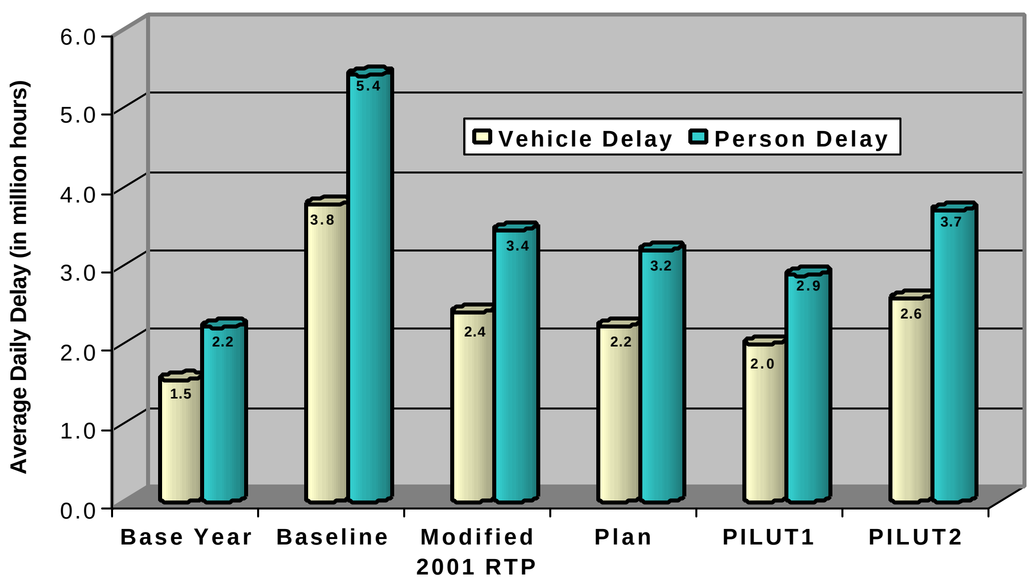


Exhibit C.9 depicts average daily person delay per capita. Delay per capita is a more accurate representation of delay trends because it accounts for population and associated travel demand growth. For instance, total delay can be increasing, but if delay per capita stays constant, then the individual traveler experiences the same performance.

Exhibit C.9: Scenario Average Daily Person Delay per Capita

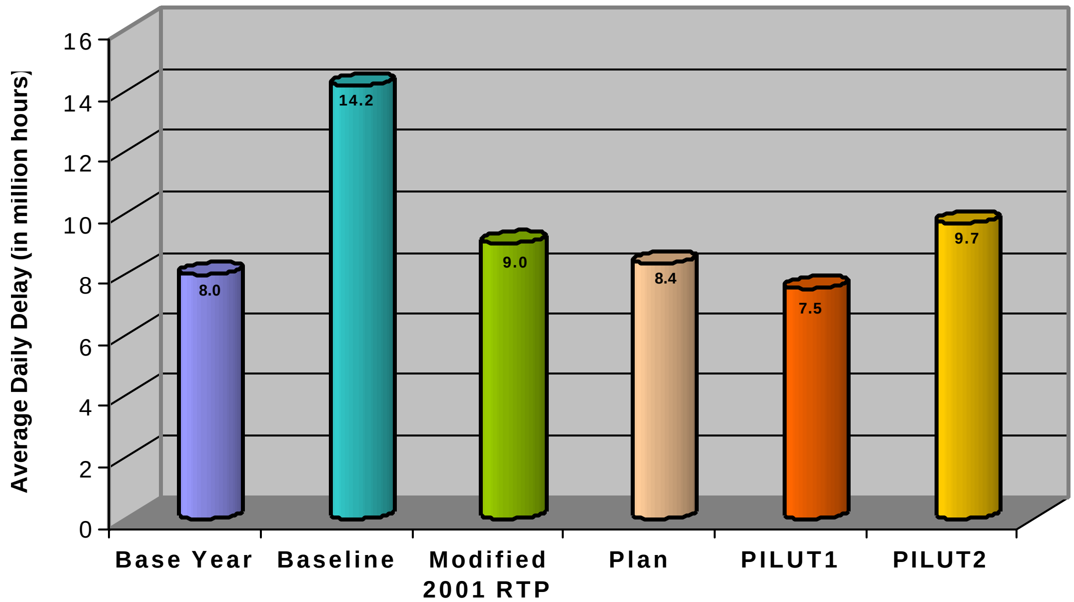
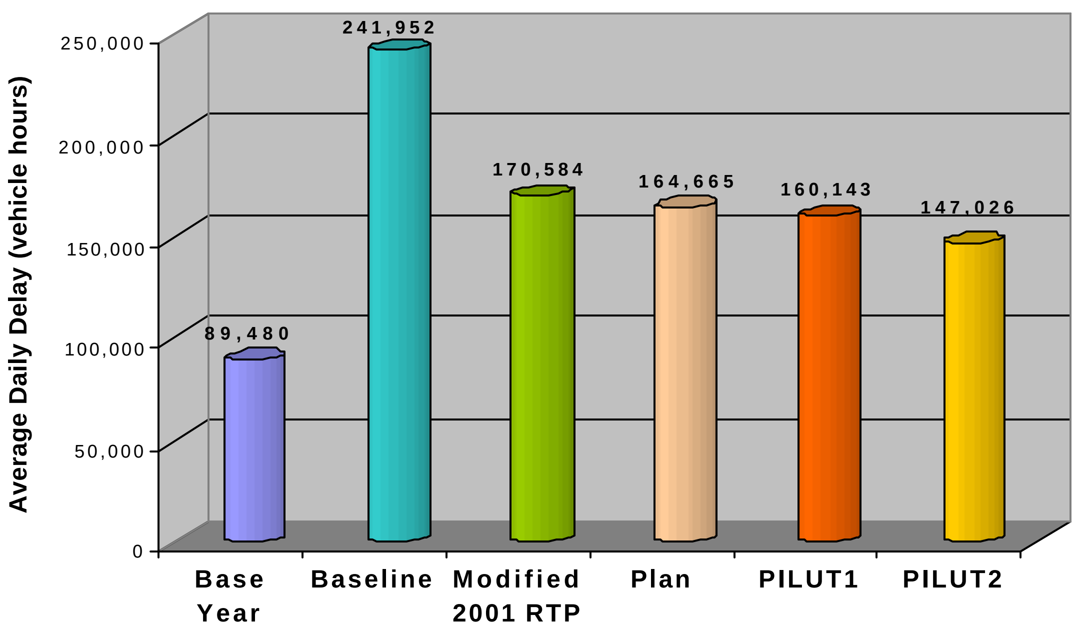


Exhibit C.10 presents the portion of the daily vehicle delays that heavy duty trucks experience on the Region's roadway system. This is an important chart since the logistics industry, which includes heavy duty truck movements, is a critical component of the Region's economy.

Exhibit C.10: Scenario Average Daily Heavy Duty Truck Delays



Accessibility

Accessibility is used to capture how well the transportation system performs in terms of providing people access to opportunities. Opportunities can include anything from jobs, education, medical care, recreation, shopping, or other activity that helps improve a person's life.

For the 2004 RTP, accessibility is defined as the percentage of the population who can travel between work and home (or between home and work) within 45 minutes during the afternoon (PM) peak period. It is believed that access to employment is a reasonable proxy for access to all opportunities, and home-to-work travel is a trip type that is readily forecast in travel demand models.

Accessibility is measured by taking PM peak period travel demand model results for the base and forecast years. The outputs used are travel time between origin and destination (OD) pairs and the model "trip tables" (i.e., number of trips between OD pairs), both being routine outputs of a travel demand model.

Results are tabulated for both transit and automobile travel, again with both modes represented in the model. Exhibits C.11 and C.12 show auto and transit accessibility results by scenario respectively.

Exhibit C.11: Scenario Auto Accessibility Results

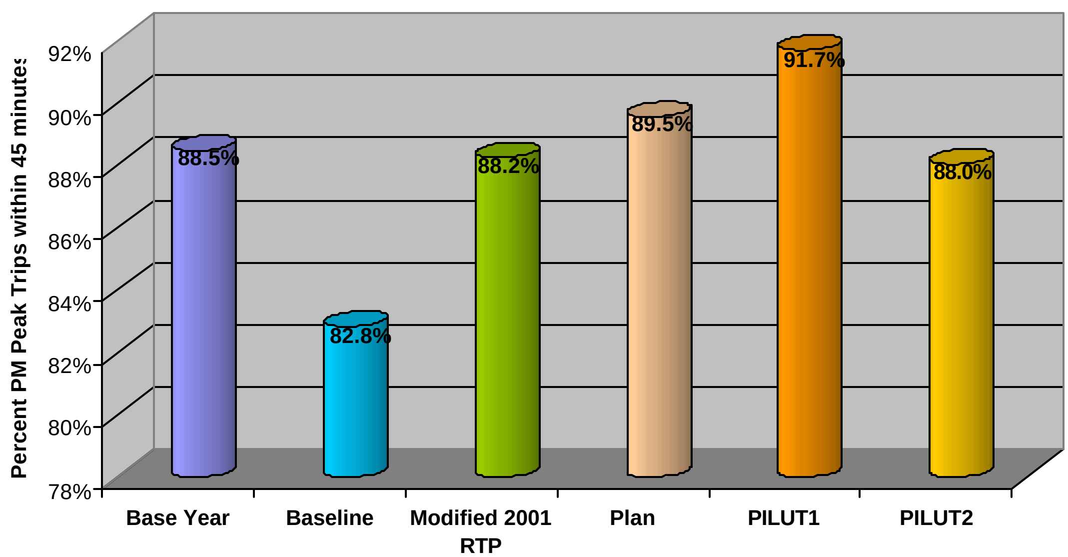
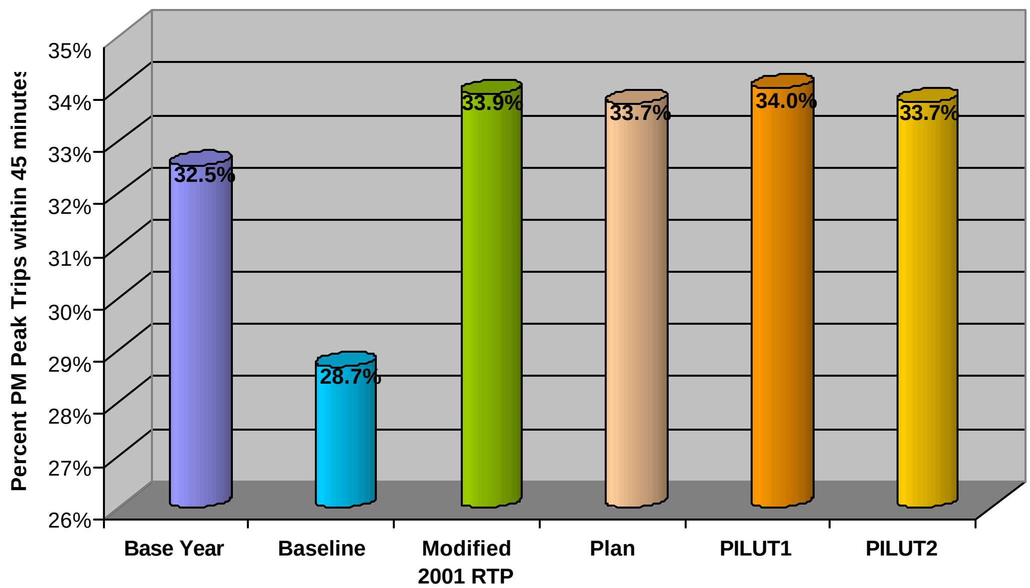


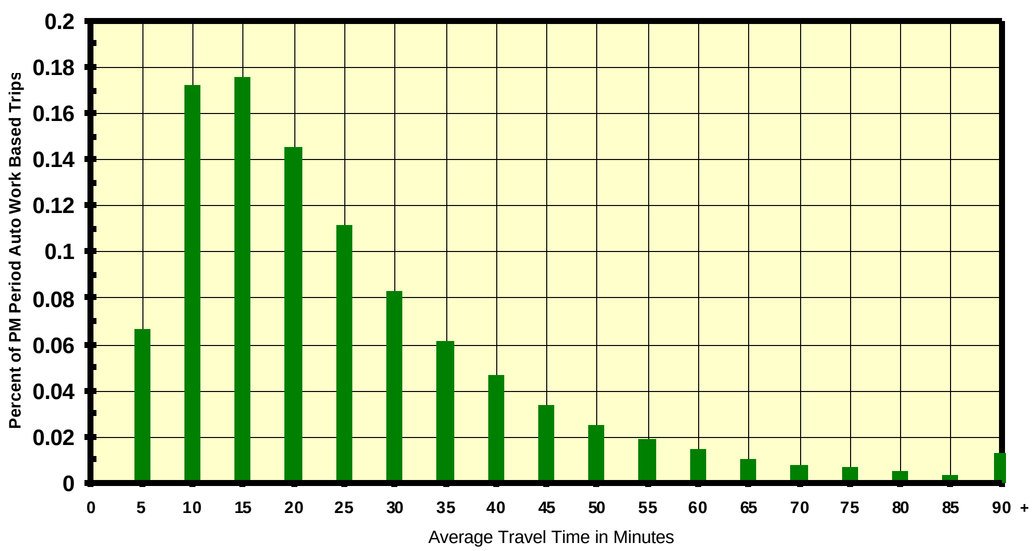
Exhibit C.12: Scenario Transit Accessibility Results



Note that overall, regardless of scenario, transit accessibility is significantly lower than auto accessibility. For instance, less than 33 percent of current work based transit trips in the pm peak period are completed within 45 minutes while almost 89 percent of the auto trips are completed within this time frame.

Exhibit C.13 shows a more detailed example of automobile accessibility for the 2004 RTP. It presents the distribution of auto trips by travel time. Each bar on the chart represents the percent of total home based trips that are completed within the time interval defined on the 'X Axis'.

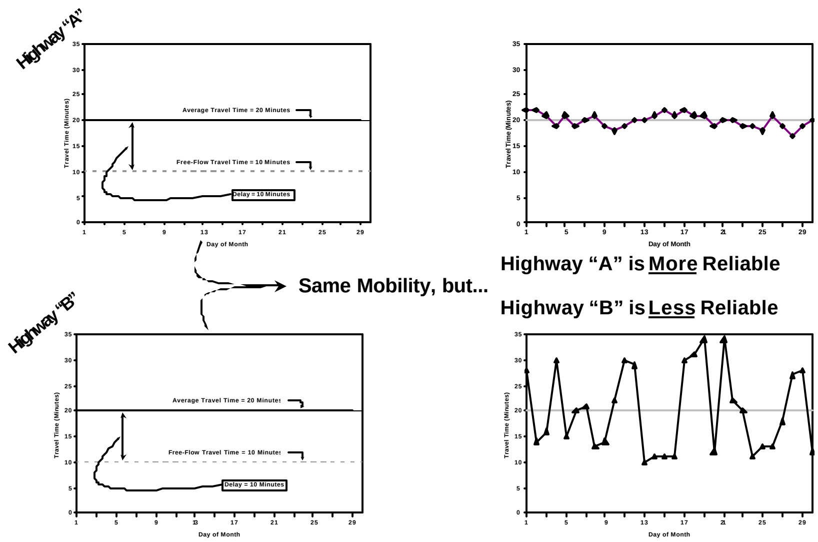
Exhibit C.13: 2004 RTP Automobile Accessibility Distribution



Reliability Results

The reliability measure captures the relative predictability of the public's travel time. Unlike mobility, which measures how fast the transportation system is moving people and accessibility which addresses how long the system must work to move people, reliability focuses on how much mobility and accessibility vary from day to day. This variability is illustrated in Exhibit C.14.

Exhibit C.14: Difference between Reliability and Mobility



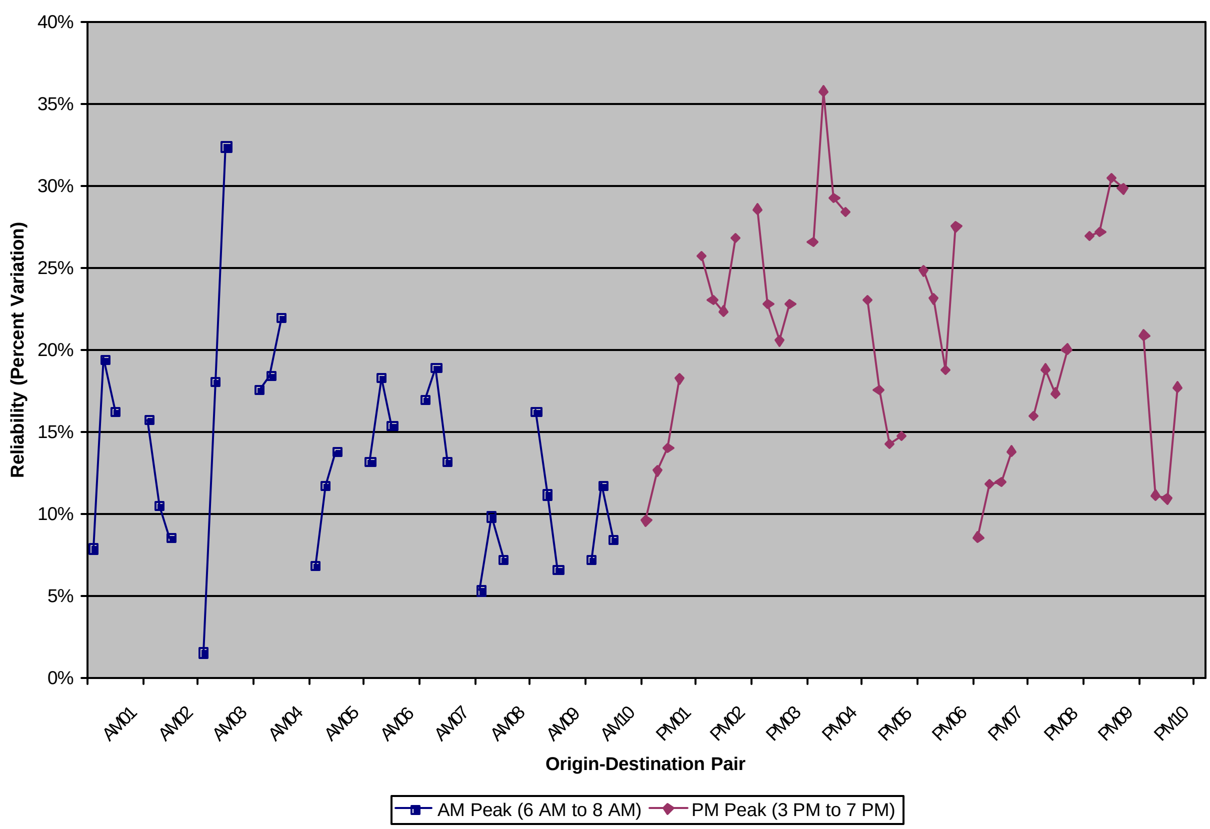
Highway "A" and Highway "B" both have the same average travel time meaning that they experience the same level of mobility. However, when each day's travel time is taken into account, one sees that Highway "A" has lower variability than Highway "B". Reliability can be calculated by using statistical tools. The standard deviation is one such tool that provides an estimate of how much the travel time on any given day will "deviate" from the average travel time. It provides the probable range of time that a motorist will arrive within his or her scheduled time. Dividing the standard deviation by the average time spent traveling produces the percent variability for an OD pair. Reliability can currently only be monitored and not forecasted. This is partly because travel demand models cannot forecast variations in travel times.

Reliability analysis is done between OD pairs much like the accessibility analysis in order to capture the individual's travel experience. Exhibit C.15 shows the major origin destination pairs used to compute current reliability. Exhibit C.16 shows how this analysis is applied for the 2004 RTP Update. The x-axis represents the top ten OD pairs for each of the two peak time periods in terms of travel volume in the SCAG region. The y-axis shows the percent variability for each hour of the peak period. For example, OD pair #3 in the AM period is between Santa Monica and Century City as shown in the table. On the graph there are three data points for AM03 (OD pair #3 in the AM period). Each data point represents one hour during the AM peak period. For AM03 the first hour of the commute period has a variability of about 18%. .

Exhibit C.15: Major Origin Destination Pairs Used to Compute Reliability

O-D Number	AM Peak	PM Peak
1	San Fernando to Canoga Park/Chatsworth	Hollywood/Century City/Beverly Hills to Santa Monica/West LA
2	Norwalk to East LA/So. Central LA	Santa Monica/West LA to Hollywood/Century City/Beverly Hills
3	Santa Monica/West LA to Hollywood/Century City/Beverly Hills	East LA/So. Central LA to Norwalk
4	East LA/So. Central LA to Hollywood/Century City/Beverly Hills	Inglewood to Torrance
5	Hollywood/Century City/Beverly Hills to Santa Monica/West LA	Canoga Park/Chatsworth to San Fernando
6	West Covina to Pasadena	Hollywood/Century City/Beverly Hills to East LA/So. Central LA
7	Torrance to Inglewood	Torrance to Inglewood
8	Hollywood/Century City/Beverly Hills to Inglewood	Hollywood/Century City/Beverly Hills to Inglewood
9	Pasadena to East LA/So. Central LA	Inglewood to Hollywood/Century City/Beverly Hills
10	Hollywood/Century City/Beverly Hills to East LA/So. Central LA	Pasadena to West Covina

Exhibit C.16: Major Origin Destination Pairs Used to Compute Reliability



Productivity Results

Productivity is a system efficiency measure. Productivity is generally defined as the ratio of output (or service) per unit of input. In the case of highways, the input to the system is the capacity of the roadways; in transit it is the number seats provided. Specifically, productivity is defined as the percent utilization of a facility or mode under peak demand conditions. The highway productivity performance measure is calculated as actual volume divided by 2,000 vehicles per hour per lane. For transit, percent utilization is calculated as peak load factor.

For highways, productivity is particularly important because the highway system loses productivity due to merging, weaving, lane closures, and incidents. These losses productivity is shown in Exhibits C.17 and C.18. The first chart shows how much vehicle throughput declines (i.e., productivity is lost) during rush hour, while Exhibit C.18 is a map showing where and how much productivity is lost in the SCAG region.

Exhibit C.17: Illustrative Highway Productivity Loss

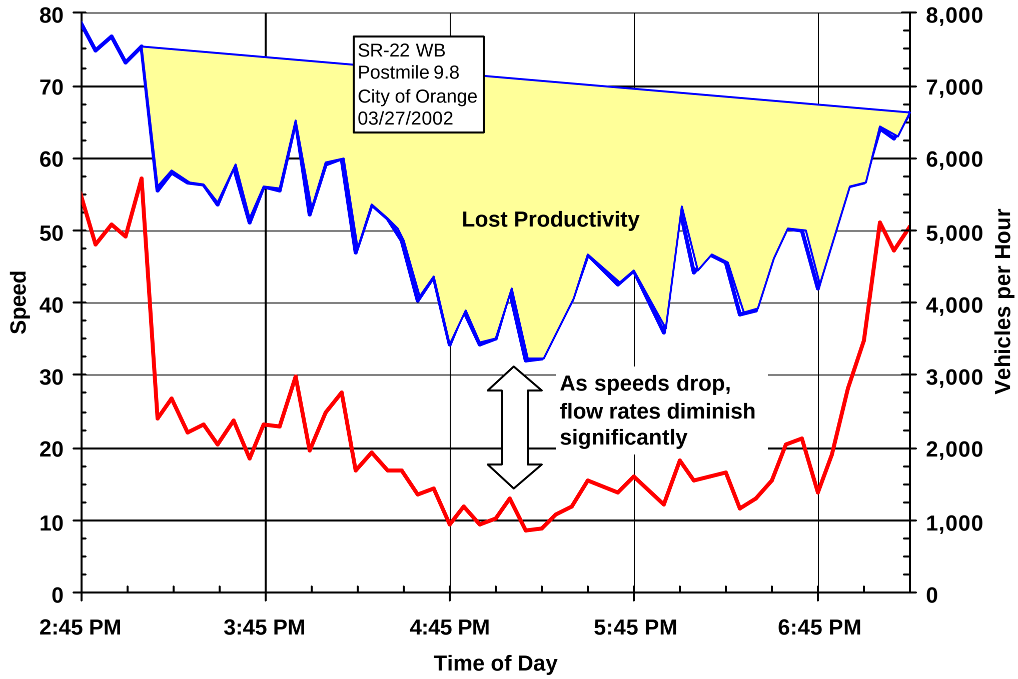
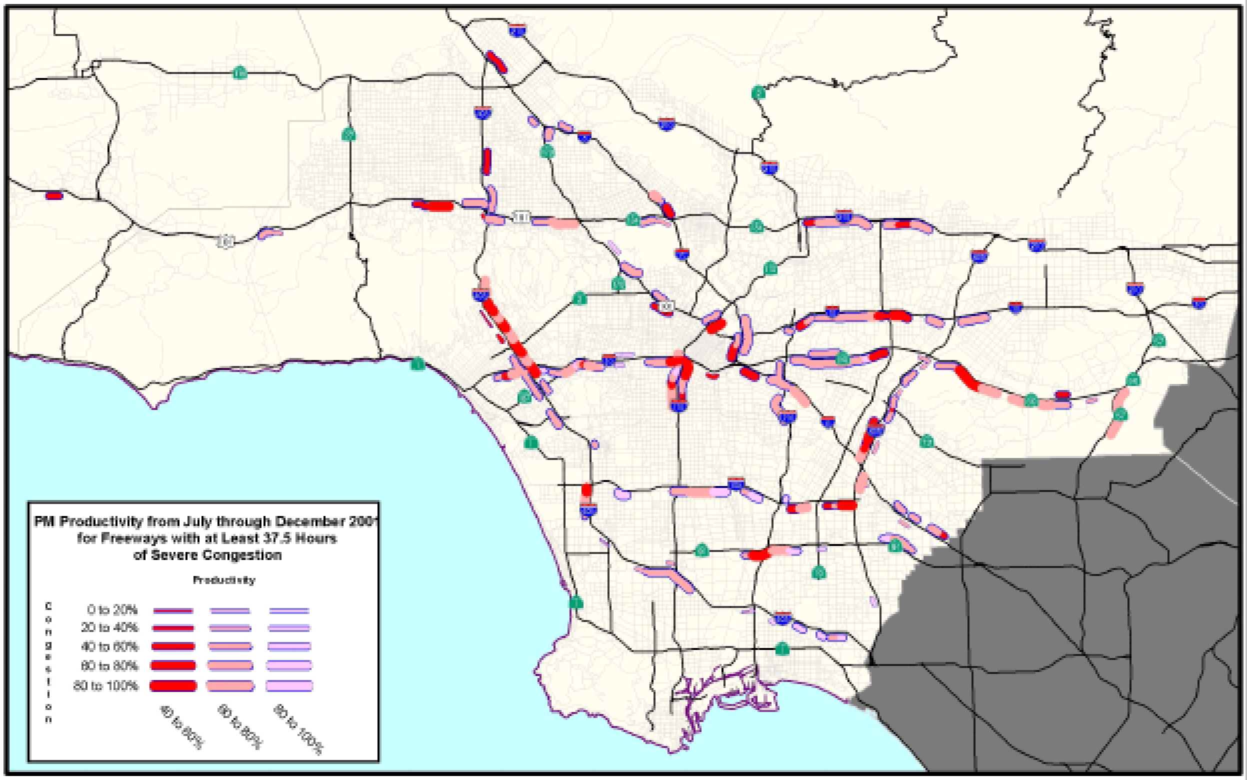
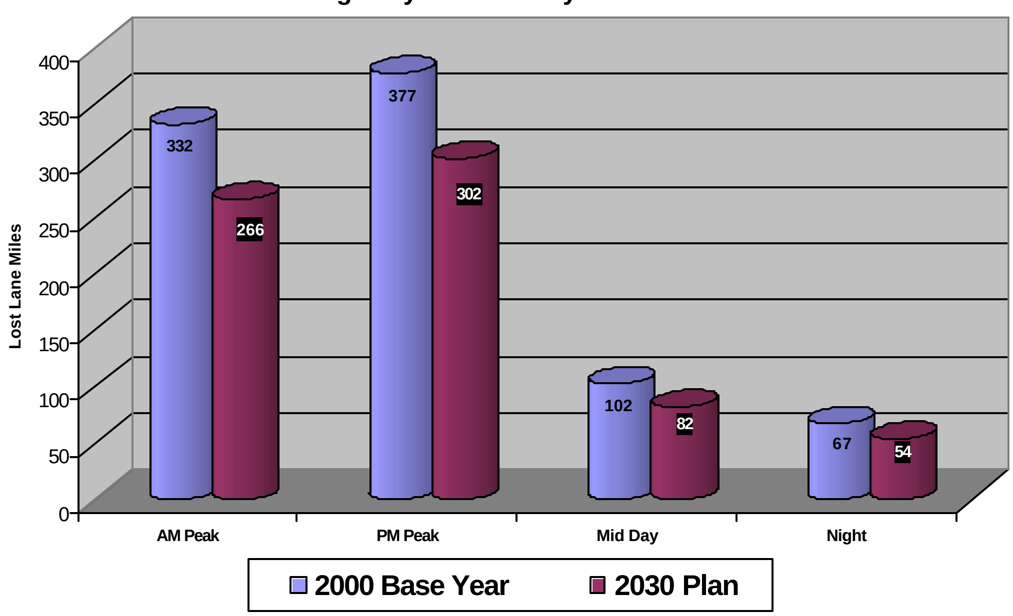


Exhibit C.18: Productivity Losses in Los Angeles



Aggregating the results of the productivity analysis for the entire SCAG region and presenting these results in terms of lane miles lost during different periods of the day produces Exhibit C.19 below.

Exhibit C.19: Highway Productivity Plan versus Base Year



Transit productivity results for the Base Year are also shown in Exhibit C.20 below. No specific targets from the plan have been estimated. However, the increased focus on transit efficiency and investments in Bus Rapid Transit should improve overall transit productivity significantly and thereby also increase overall fare box recovery ratios shown in Exhibit C.21.

Exhibit C.20: Base Year 2000 Transit Productivity

<table>
<tr><th>County</th><th>Commuter Rail</th><th>Demand Response</th><th>Heavy Rail</th><th>Light Rail</th><th>Bus</th></tr>
<tr><td>Los Angeles County</td><td rowspan="5">34%</td><td>11%</td><td>35%</td><td>59%</td><td>34%</td></tr>
<tr><td>Orange County</td><td>13%</td><td colspan="2" rowspan="4">n/a</td><td>27%</td></tr>
<tr><td>Riverside County</td><td>9%</td><td>26%</td></tr>
<tr><td>San Bernardino County</td><td>12%</td><td>33%</td></tr>
<tr><td>Ventura County</td><td>16%</td><td>22%</td></tr>
</table>

Exhibit C.21: Base Year 2000 Fare Box Recovery Ratios

County	Population 2000	Total Person Trips 2000 (Transit & Non-transit)	Public Subsidy	Total Funding	Farebox Recovery (Unsubsidized)	Farebox Recovery (Directly Generated)	Annual Public Subsidy per Capita
Los Angeles County	9,576,497	31,588,516	$736,551,358	$1,099,911,627	33%	33%	$76.91
Orange County	2,864,196	10,499,600	$66,530,050	$124,940,750	42%	42%	$23.23
Riverside County	1,525,325	4,896,121	$30,651,986	$38,892,369	21%	21%	$20.10
San Bernardino County	1,696,904	5,475,741	$27,783,603	$39,845,344	30%	30%	$16.37
Ventura County	758,096	2,721,417	$9,289,979	$11,900,218	22%	22%	$12.25

Preservation Results

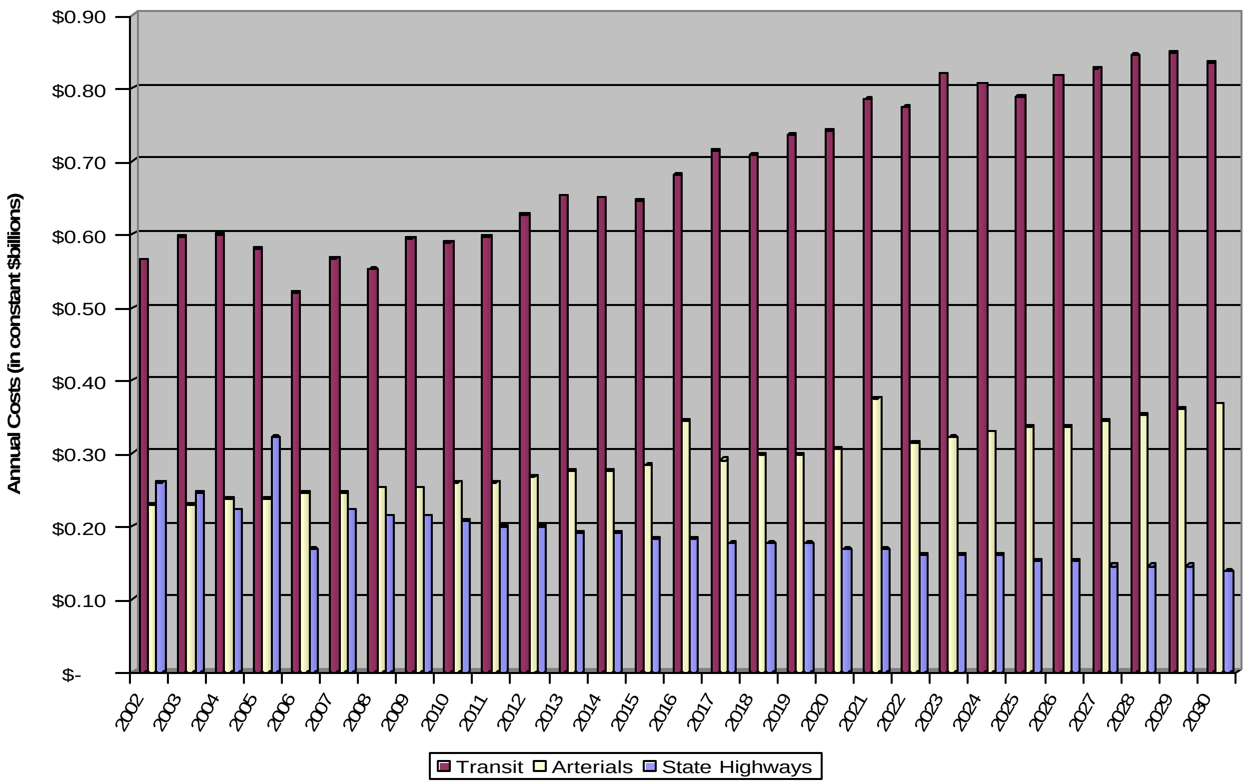
Preservation is a sub-set of sustainability. Preservation is measured as the inflation adjusted costs per capita to maintain the system at current conditions per person in the region.

If the indicator grows over time, this means that our current resource limitations and decisions are creating a situation where future generations will have to pay more to get the same performance or "make do" with reduced performance.

Over time, this measure and its trend will reflect whether we are taking care of our existing infrastructure. If the measure shows a substantial increase over time, it would mean that we are not taking care of our existing system and therefore the costs to get the system to Base Year 2000 conditions is increasing over time.

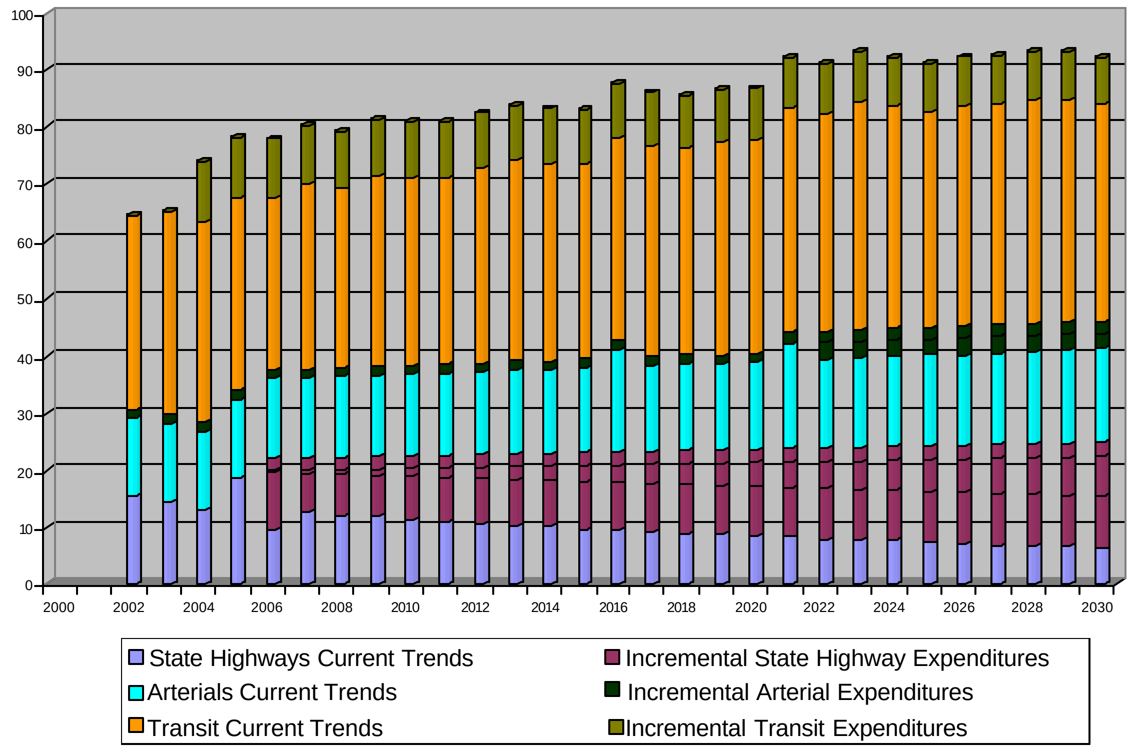
Exhibit C.22 presents preservation expenditure forecasts based on current revenue trends. The forecasted expenditures are divided into State Highway, Arterials, and Transit. As the exhibit demonstrates, State Highway preservation expenditures are expected to decline over time. The RTP addresses this alarming trend by allocating additional funds recognizing that the infrastructure is aging, and if anything, requires increased funding.

Exhibit C.22: System Preservation Expenditure Forecast Based on Current Revenue Trends



After analyzing needs and trends, the RTP specifies increased funding for all three modes for preservation purposes. The total additional investment will be $6.5 billion. The resulting expenditures, once increased, and divided by the region's total forecasted population yields the Plan cost per capita for preservation. These are presented in Exhibit C.23 and range from $60 per year per person to $100 per year per person (in constant dollars).

Exhibit C.23: System Preservation Projected Costs per Capita



Sustainability Results

A transportation system is sustainable if problems with the system generated by current users are not passed on for future generations to maintain. The sustainability performance measure is defined as the total costs to maintain overall system performance at current conditions are divided by the total population. As such, preservation can be viewed as a subset of sustainability.

Inflation adjusted cost per capita to maintain the current level of performance of our multi-modal transportation system is how sustainability will be calculated. This measure and its trend over time will tell us whether our decisions are placing burdens on future generations.

If the indicators grow over time, this means that our current resource limitations and decisions are creating a situation where future generations will have to pay more to get the same performance (or live with reduced performance)

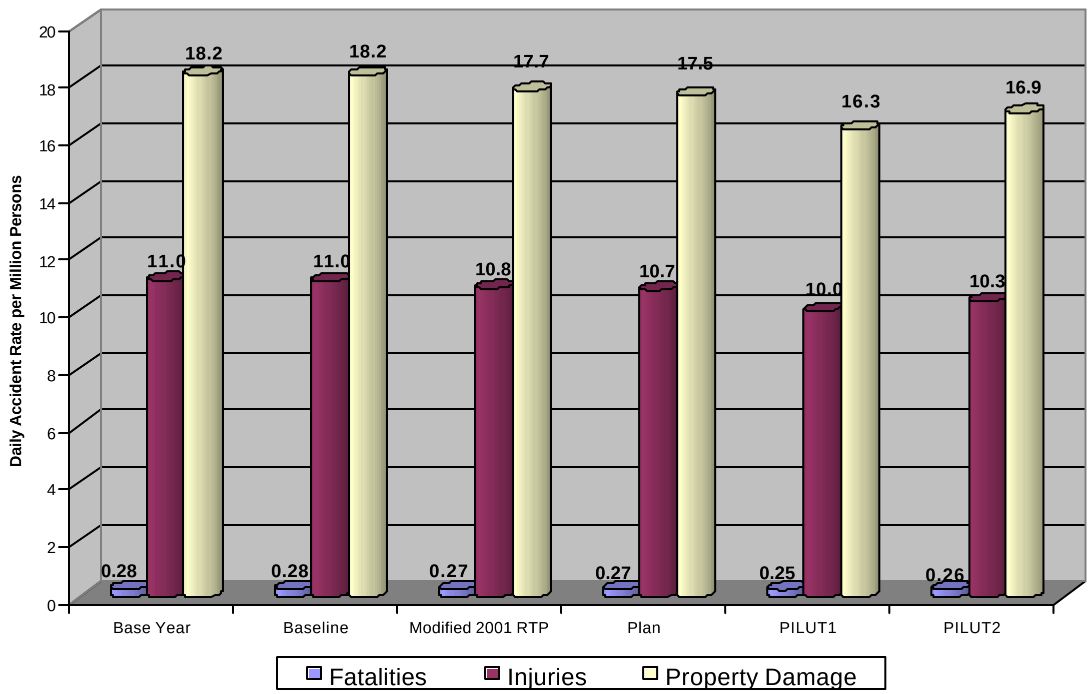
Sustainability results indicate that overall costs per capita will remain the same with the exception of preservation costs. The Plan maintains and/or improves levels of service as reflected by the mobility, accessibility, reliability, and productivity indicators. Given the aging infrastructure we have, it is understandable that preservation costs grow over time.

Safety Results

Safety measures how well the transportation system minimizes accidents. Safety is presented as fatalities, injuries, and property damage accidents per million persons by mode. Safety data is routinely collected by the California Highway Patrol, Caltrans, and local transit agencies.

Safety cannot be forecast, but total accidents can show a reduction in future years if people shift modes from higher accident modes to lower accident modes. Exhibit C.24 presents the accident rates by scenario. The rates are calculated using collision data for the region from Caltrans and transit data for regional transit operators from the National Transit Database. The current highway and transit accident rates are applied to projections of system usage produced by the regional travel demand model, then presented on a per million persons basis.

Exhibit C.24: Scenario Daily Accident Rates per Million Persons



Cost Effectiveness Results

Cost-effectiveness refers to the potential for receiving the greatest return possible on monetary investments in the transportation system. The cost-effectiveness of investments is considered from the perspective of the public provider and taxpayer. The indicator for cost-effectiveness is the benefit-cost ratio.

Deriving Net Present Value and the Benefit-Cost Ratio

The purpose of benefit-cost analysis is to facilitate the more efficient allocation of society's scarce resources. Because SCAG, like many other Metropolitan Planning Organizations (MPOs) throughout the nation, is faced with the challenge of expanding transportation investment at a time when financial resources are scarce, benefit-cost analysis is critical.

A benefit-cost model is utilized to demonstrate the 2004 RTP's efficiency. The incremental costs of the 2004 Plan are compared to the benefits in the form of a ratio of one dollar spent for a certain amount of dollar benefits.

Costs, as analyzed here, include public expenditures over the life cycle of the project(s) under consideration (as applicable). Additionally, the benefits assessed are mobility-related benefits including:

- Delay savings,
- Accident reduction,
- Savings in vehicle operating costs, and
- Air-quality benefits.

Benefits are assumed to be realized beginning in 2010 when a majority of the projects in the Plan are expected to be completed and in operation. Incrementally increasing levels of benefits are captured through 2030 and then remain flat through 2040 (an estimated 30-year life span).

SCAG derived benefit measure levels by assessing the difference between the 2030 Baseline and the 2030 Plan (including Tier 2). Assumed monetary values for each of these benefit measures are further discussed in the following:

Exhibit C.25

Assumptions for Value of Time	
Value of Hour Saved for Passenger Vehicles	**Value of Hour Saved for Trucks**
$9.92[1]	$66.50[2]
(1) Value is assumed to be 50% of average wage rate for the Region. According to the Bureau of Labor Statistics, the average wage rate for April of 2002 was $19.84 (LA, Riverside, Orange Survey). This estimate is then multiplied by the average vehicle occupancy rate of 1.4 assumed for the Region. (2) An average was estimated based upon recent research and conversations with the US DOT, Freight Operations & Management. Estimates can range between $30 to $145 according to FHWA.	

Exhibit C.26

Arterial & Freeway Accident Rates with Associated Costs *(Per Million Vehicle Miles)*			
Type of Accident	**Arterial Rate**	**Freeway Rate**	**Cost Per Event**
Fatal	0.0206	0.0059	$3,293,817
Injury	0.7237	0.2712	$86,540
Property	0.9505	0.7241	$7,267
Source: Caltrans			

Exhibit C.27

Bus & Rail Accident Rates with Associated Costs *(Per Million Vehicle Miles)*			
Type of Accident	**Bus Rate**	**Rail Rate**	**Cost Per Event**
Fatal	0.067	0.539	$2,875,039
Injury	19.005	10.370	$69,584
Source: National Transit Database			

Exhibit C.28

Health Cost of Transportation Emissions For LA/South Coast *(2002$/ton)*				
CO	**NOx**	**PM_{10}**	**Sox**	**VOC**
$122	$49,454	$405,114	$152,206	$3,074
Source: UC Davis Study – McCubbin and Delucchi				

Exhibit C.29

Fuel & Non-Fuel Cost Assumptions *(2002$)*	
Fuel Cost	$1.31/gal.
Non-Fuel Cost	
Passenger	$0.175/mile
Truck	$0.302/mile
Source: Caltrans	

Exhibit C.30

Fuel Consumption Rates (gal./mile)		
Speed	**Auto**	**Truck**
5	0.182	0.310
10	0.123	0.181
15	0.089	0.135
20	0.068	0.118
25	0.054	0.120
30	0.044	0.133
35	0.037	0.156
40	0.034	0.185
45	0.033	0.223
50	0.033	0.264
55	0.034	0.316
60	0.037	0.374
65	0.043	0.439
70	0.052	0.511
Source: Caltrans, ARB		

Public decisions to build transportation projects often have important consequences over an extended period of time. The SCAG Region is expected to incur costs and accumulate benefits over a number of years. Because projects with different flows of benefits and costs arise over different time periods, an inter-temporal analysis is utilized. That is, the mechanics of discounting are used to ensure that future costs and benefits are in a common metric: the present value. The methodology utilized is further discussed in the following.

First, real or constant dollar terms were derived, for both cost and benefit values by adjusting for changes in inflation, assuming a 3 percent deflation factor and using a base year of 2002. These constant dollar values were further discounted by the real discount rate of an estimated 5 percent in order to obtain the Net Present Value (NPV) and in turn, the Benefit/Cost (B/C) ratio in present-value terms. The assumptions used to calculate the NPV and B/C ratios are as follows:

Exhibit C.31

Assumptions Used to Calculate Present Value	
Nominal Discount Rate	*8%*
Inflation Rate	*3%*
Real Discount Rate	*5%*
Note: the nominal discount rate was derived based upon conversations with Caltrans' Economic Planning Department staff and further literature review.	

Exhibit C.32

2004 RTP Benefit-Cost Analysis	
Project	**Benefit/Cost (Value of One Dollar Invested)**
2004 RTP *(present value $)*	$ 3.08
2004 RTP *(constant $)*	$ 5.05

Exhibit C.33 below represents the scenario results for the benefit cost analysis.

Exhibit C.33

SCAG Regional Performance Analysis Benefit Cost Results				
Project	**Value of $1 Invested**			
	Plan	**Modified 2001 RTP**	**PILUT1**	**PILUT2**
2004 RTP (present value)	$ 3.08	$ 2.59	$ 4.58	$ 3.09
2004 RTP (constant dollar)	$ 5.05	$ 4.25	$ 7.52	$ 5.06

Environmental Justice Measure

Refer to Appendix G for the Environmental Justice analysis.

Environmental Justice is an analysis that assesses how fairly SCAG administers federal funds. Title VI of the Civil Rights Act of 1964 requires this by stating:

> *"No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."*

In the 1990's, the federal executive branch issued orders on environmental justice that amplified Title VI, in part by providing protections on the basis of income as well as race. These included President Clinton's Executive Order 12898 (1994), a U.S. Department of Transportation order (1997), and a Federal Highway Administration order (1998). SCAG is expected to conduct environmental justice analyses, as well as public outreach, to comply with these orders and with federal planning regulations.

SCAG uses the environmental justice analyses to help its elected officials make transportation planning decisions fairly. The analyses are designed to assure that benefits and burdens are not distributed unfairly across populations in the region. However, the goal of federal environmental justice policy is not to guarantee entitlements but rather to prevent discriminatory effects. Federal environmental justice guidance documents require the analysis of impacts on “minority” populations, and defines “minority” specifically to mean all ethnic and racial groups other than white. The 2004 RTP Update will analyze the share of net benefits and costs by mode, household income, and race/ethnicity; and will include the following analyses:

- RTP expenditures
- Taxes paid (e.g., income, sales & use, gasoline)
- Travel time savings (overall, transit, auto)
- Access to jobs
- Environmental impacts from PEIR

For the last analysis above, the recommendation is to work with the South Coast Air Quality Management District (SCAQMD) to include their Urban Airshed Model (UAM) in the environmental justice analysis. UAM is a three-dimensional photochemical grid model mainly used to study the photochemical air quality pertaining to ambient ozone concentrations. High ozone concentrations lead to adverse health effects. Ozone is primarily formed in the atmosphere through a complex chemical mechanism involving oxides of nitrogen (NO) and volatile organic compounds (VOCs) in the presence of sunlight. Since UAM accounts for spatial and temporal changes, it can be used to evaluate the effects of emission control scenarios on urban air quality.[1]

Environmental Measure

Refer to Appendix E for the Transportation Conformity Report.

SCAG, as the federally mandated MPO, has to meet federal and state environmental requirements for the 2004 RTP Update to be approved. Therefore, the environmental performance measure is for the 2004 RTP Update to meet State Implementation Plan (SIP) Emission Budget & Transportation Conformity requirements. Measured emissions for these requirements include: Carbon Monoxide (CO), Nitrous Oxide (NOX), particulate matter (PM10), Sulfur Oxide (SOX), and Volatile Organic Compounds (VOC). Carbon Dioxide (CO2) can be used as a secondary measure to reflect greenhouse emissions.

The Transportation Conformity Analysis covers all federally required analyses for conformity determination of the 2004 RTP Update. All transportation and air quality conformity analyses must be in compliance with the Environmental Protection Agency (EPA) Transportation Conformity Rule (40 CFR Parts 51 and 93, published on August 15, 1997). Additionally, the conformity analyses must be consistent with all court cases.

Federal transportation and air quality regulations are outlined in TEA-21 and the Federal Clean Air Act (CAA). TEA-21 authorizes Federal funding for highway, highway safety, transit, and other surface transportation programs. The CAA establishes air quality standards for various health-hazardous pollutants. California State requirements for air quality management are incorporated into the SIP for those pollutants stipulated in the CAA. The SIPs set forth the goals and objectives for achieving CAA air-quality standards.

[1] The first regulatory use and practical applications of the UAM were done for the Denver area on behalf of the Colorado Division of Highways and EPA's Region VII in 1978. UAM was used to evaluate whether various transportation plans and programs were consistent with the SIP and to evaluate the effects on Denver's air quality of urban growth and development that might result from the construction of proposed wastewater treatment facilities. In the late 1970s, EPA's OAQPS initiated a program to examine the applicability and practicality of the UAM in routine ozone attainment demonstrations required by the SIP process. Data collection, emission inventory development, model performance evaluation and application were major elements of this nation-wide program. Building off the St. Louis UAM applications and an extensive series of UAM sensitivity studies designed to provide guidance concerning the types and amounts of data required to support the UAM application, data for an application of the UAM, supported by OAQPS, were collected in Tulsa, Philadelphia/New Jersey, Baltimore/Washington and New York.

The EPA may make a Federal “non-attainment area” designation to any area that has not met CAA health standards for one or more pollutant. A non-attainment area designation may require additional air quality controls for transportation plans, programs, and projects.

To comply with the CAA in achieving the National Ambient Air Quality Standards (NAAQS), the California Air Resources Board (ARB) develops SIPs for Federal non-attainment areas. In California, SIP development is a joint effort of the local air agencies and ARB working with Federal, State, and local agencies (including the MPOs). Local Air Quality Management Plans (AQMPs) are prepared in response to Federal and State requirements.

The SIP includes two important factors for transportation and air quality conformity analysis – emissions budgets and Transportation Control Measures (TCM). Emissions budgets set an upper limit which transportation activities are permitted to emit. TCMs are strategies to reduce emission from on–road mobile sources.

ARB recommends the federal non-attainment area boundaries to EPA for final designations. Subsequently, the EPA finalizes and defines the boundaries of the federally designated non-attainment areas for each criteria pollutant (as defined below). In general, each Federal non-attainment area should be in one air basin. However, in the SCAG region, one Federal non-attainment area may cover portions of several air basins. In California, the ARB or State legislature defines the air basins.

In compliance with the CAA requirements, the Transportation Conformity Rule establishes regulatory provisions for processing transportation plans, programs, and projects in non-attainment areas under Title 23 U.S.C., the Federal Transit Act, and Section 176(c) of the 1990 CAA Amendment. The Rule also regulates conformity to the SIPs.

For further details of the 2004 RTP conformity analysis, refer to Appendix E for the Transportation Conformity Report.

Modeling Summary

The following is a summary of model output for the Base Year, Baseline/No Project and Plan scenarios for the five-county modeling area[2] only. For more information on the regional travel demand model, refer to the Modeling Summary portion of Technical Appendix E – Transportation Conformity.

Exhibit C.34

	2000 Base Year	2005 Baseline	2005 Plan	2010 Baseline	2010 Plan	2015 Baseline	2015 Plan	2020 Baseline	2020 Plan	2025 Baseline	2025 Plan	2030 Baseline	2030 Plan
Total Person Trips													
Los Angeles County	31,590,000	32,707,000	32,674,000	34,557,000	34,475,000	35,987,000	35,724,000	37,273,000	37,404,000	38,293,000	39,042,000	39,524,000	40,170,000
Orange County	10,478,000	10,929,000	10,918,000	11,782,000	11,756,000	12,095,000	12,046,000	12,348,000	12,271,000	12,531,000	12,490,000	12,774,000	12,678,000
Riverside County	4,909,000	5,625,000	5,621,000	6,677,000	6,664,000	7,579,000	7,558,000	8,428,000	8,516,000	9,158,000	9,571,000	10,026,000	10,322,000
San Bernardino County	5,488,000	5,906,000	5,900,000	6,488,000	6,474,000	6,945,000	7,100,000	7,565,000	7,726,000	8,101,000	8,346,000	8,648,000	8,844,000
Ventura County	2,723,000	2,887,000	2,884,000	3,103,000	3,097,000	3,208,000	3,220,000	3,315,000	3,347,000	3,445,000	3,509,000	3,606,000	3,622,000
TOTAL	55,188,000	58,053,000	57,997,000	62,607,000	62,465,000	65,815,000	65,649,000	68,928,000	69,265,000	71,529,000	72,959,000	74,578,000	75,636,000
Total Person Trips by Trip type													
Home Based Work	8,937,000	9,197,000	9,141,000	10,169,000	10,039,000	10,637,000	10,414,000	11,182,000	10,908,000	11,213,000	11,411,000	11,709,000	11,644,000
Home Based University	1,757,000	1,993,000	1,993,000	2,288,000	2,288,000	2,314,000	2,326,000	2,337,000	2,364,000	2,399,000	2,403,000	2,441,000	2,441,000
Home Based School	5,210,000	5,305,000	5,305,000	5,553,000	5,553,000	5,685,000	5,884,000	6,059,000	6,214,000	6,439,000	6,544,000	6,873,000	6,873,000
Home Based Other	21,604,000	23,021,000	23,021,000	24,568,000	24,562,000	26,067,000	25,912,000	27,187,000	27,430,000	28,557,000	29,002,000	29,648,000	30,101,000
Other Based Other	11,670,000	12,393,000	12,393,000	13,242,000	13,236,000	14,017,000	13,977,000	14,659,000	14,797,000	15,367,000	15,621,000	15,976,000	16,281,000
Work Based Other	6,010,000	6,145,000	6,145,000	6,788,000	6,788,000	7,096,000	7,137,000	7,505,000	7,552,000	7,554,000	7,978,000	7,931,000	8,297,000
TOTAL	55,188,000	58,054,000	57,998,000	62,608,000	62,465,000	65,815,000	65,649,000	68,929,000	69,265,000	71,529,000	72,959,000	74,578,000	75,636,000

Numbers may not add due to rounding

[2] The data presented in Exhibit C.34 represent the 5-county modeling area, including all of Ventura, Los Angeles, and Orange Counties; the western portion of Riverside County, including the Morongo and Coachella Valleys; and the southwestern portion of San Bernardino County, including the San Bernardino Valley and the Victor Valley north to Barstow. Where possible, the performance measures calculated elsewhere in this Appendix include Imperial County, therefore the numbers presented in Exhibit C.34 may be slightly different.

	2000 Base Year	2005 Baseline	2005 Plan	2010 Baseline	2010 Plan	2015 Baseline	2015 Plan	2020 Baseline	2020 Plan	2025 Baseline	2025 Plan	2030 Baseline	2030 Plan
Home To Work/University Person Trips Mode Choice													
Drive Alone	8,199,000	8,415,000	8,381,000	9,359,000	9,068,000	9,716,000	9,391,000	10,168,000	9,767,000	10,243,000	10,127,000	10,654,000	10,301,000
%	76.7	75.2	75.3	75.1	73.6	75.0	73.7	75.2	73.6	75.2	73.3	75.3	73.1
Carpool	1,514,000	1,671,000	1,651,000	1,879,000	1,807,000	1,968,000	1,848,000	2,050,000	1,901,000	2,069,000	1,951,000	2,144,000	1,949,000
%	14.2	14.9	14.8	15.1	14.7	15.2	14.5	15.2	14.3	15.2	14.1	15.1	13.8
Transit	513,000	576,000	572,000	630,000	754,000	657,000	778,000	669,000	852,000	664,000	956,000	691,000	1,041,000
%	4.8	5.1	5.1	5.1	6.1	5.1	6.1	4.9	6.4	4.9	6.9	4.9	7.4
Non-Motorized	467,000	529,000	530,000	588,000	697,000	610,000	722,000	632,000	752,000	636,000	779,000	662,000	793,000
%	4.4	4.7	4.8	4.7	5.7	4.7	5.7	4.7	5.7	4.7	5.6	4.7	5.6
Home-Work Vehicle Persons	9,713,000	10,086,000	10,032,000	11,238,000	10,875,000	11,684,000	11,239,000	12,219,000	11,668,000	12,312,000	12,078,000	12,797,000	12,250,000
Home-Work Vehicle Drivers	8,827,000	9,102,000	9,061,000	10,131,000	9,810,000	10,524,000	10,152,000	11,010,000	10,552,000	11,093,000	10,934,000	11,534,000	11,109,000
Average Vehicle Occupancy	1.100	1.108	1.107	1.109	1.109	1.110	1.107	1.110	1.106	1.110	1.105	1.110	1.103
Total Person Trips Mode Choice													
Drive Alone	26,464,000	27,339,000	27,309,000	29,864,000	29,173,000	31,441,000	30,637,000	33,027,000	32,382,000	34,110,000	34,154,000	35,573,000	35,310,000
%	48.0	47.1	47.1	47.7	46.7	47.8	46.7	47.9	46.8	47.7	46.8	47.7	46.7
Carpool	22,200,000	23,854,000	23,823,000	25,466,000	24,975,000	26,786,000	26,232,000	27,976,000	27,570,000	29,185,000	28,939,000	30,382,000	29,953,000
%	40.2	41.1	41.1	40.7	40.0	40.7	40.0	40.6	39.8	40.8	39.7	40.7	39.6
Transit	1,188,000	1,297,000	1,294,000	1,366,000	1,881,000	1,415,000	1,982,000	1,434,000	2,133,000	1,449,000	2,323,000	1,489,000	2,521,000
%	2.2	2.2	2.2	2.2	3.0	2.2	3.0	2.1	3.1	2.0	3.2	2.0	3.3
School Bus	736,000	763,000	761,000	762,000	761,000	770,000	791,000	811,000	817,000	856,000	842,000	900,000	870,000
%	1.3	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Non Motorized	4,600,000	4,800,000	4,810,000	5,149,000	5,675,000	5,402,000	6,006,000	5,680,000	6,363,000	5,928,000	6,701,000	6,235,000	6,982,000
%	8.3	8.3	8.3	8.2	9.1	8.2	9.1	8.2	9.2	8.3	9.2	8.4	9.2
Total Vehicle Persons	48,664,000	51,193,000	51,132,000	55,331,000	54,148,000	58,227,000	56,869,000	61,003,000	59,952,000	63,295,000	63,092,000	65,955,000	65,263,000
Total Vehicle Drivers	33,968,000	35,458,000	35,418,000	38,555,000	37,672,000	40,620,000	39,552,000	42,590,000	41,742,000	44,058,000	43,966,000	45,886,000	45,436,000
Average Vehicle Occupancy	1.4327	1.4438	1.4437	1.4351	1.4373	1.4335	1.4378	1.4323	1.4362	1.4366	1.4350	1.4374	1.4364

Numbers may not add due to rounding

	2000 Base Year	2005 Baseline	2005 Plan	2010 Baseline	2010 Plan	2015 Baseline	2015 Plan	2020 Baseline	2020 Plan	2025 Baseline	2025 Plan	2030 Baseline	2030 Plan
Daily Transit Boardings													
Metrolink	30,000	35,000	35,000	48,000	65,000	54,000	64,000	66,000	84,000	77,000	88,000	94,000	98,000
MTA bus	1,247,000	1,367,000	1,361,000	1,432,000	1,916,000	1,473,000	1,981,000	1,477,000	2,098,000	1,478,000	2,178,000	1,502,000	2,232,000
MTA Rail	210,000	242,000	241,000	268,000	316,000	282,000	407,000	293,000	481,000	300,000	529,000	317,000	623,000
Others	711,000	800,000	795,000	844,000	1,067,000	879,000	1,071,000	891,000	1,123,000	894,000	1,258,000	919,000	1,336,000
Maglev	--	--	--	--	--	--	--	--	104,000	--	194,000	--	371,000
TOTAL	2,199,000	2,443,000	2,432,000	2,592,000	3,364,000	2,688,000	3,524,000	2,727,000	3,889,000	2,749,000	4,247,000	2,832,000	4,661,000
Average Trip Length (Time and Distance)													
Home-To-Work Travel Time (minutes)	21.6	20.3	19.7	22.0	21.0	22.8	20.6	24.0	20.8	24.9	21.1	25.9	20.8
Travel Distance (miles)	12.6	12.0	11.8	12.5	12.3	12.6	12.0	12.7	12.0	12.8	12.1	12.7	12.0
All Trip Types Travel Time (minutes)	13.6	13.4	13.2	14.0	13.5	14.2	13.3	14.5	13.3	14.8	13.4	15.1	13.3
Travel Distance (miles)	7.9	8.0	7.9	8.0	7.9	7.9	7.8	7.9	7.7	7.8	7.7	7.8	7.7
Average Travel Speed (miles per hour, Light and Medium Duty Vehicles)													
Total Modeling Area (Daily)													
Avg Mixed Flow Speed	49.6	50.7	51.2	48.5	50.1	46.9	50.1	44.9	49.5	43.7	49.0	42.1	49.6
Avg HOV Speed	52.9	53.6	53.9	51.0	52.6	49.7	52.9	48.0	52.8	46.8	52.5	45.4	52.6
Avg Arterial Speed	30.4	30.5	30.6	29.7	30.5	29.2	30.4	28.6	30.2	28.0	30.0	27.3	29.8
Avg Speed (All Facilities)	35.3	35.8	35.9	34.7	35.5	33.9	35.3	32.9	34.9	32.2	34.6	31.3	34.6
SCAB Area (Daily)													
Avg Mixed Flow Speed	48.7	49.8	50.3	47.5	49.1	45.8	49.0	43.8	48.4	42.5	47.9	40.9	48.5
Avg HOV Speed	52.9	53.5	53.9	50.9	52.5	49.6	52.8	47.9	52.5	46.7	52.2	45.3	52.3
Avg Arterial Speed	29.4	29.5	29.5	28.7	29.4	28.1	29.3	27.5	29.1	27.0	28.8	26.3	28.7
Total Modeling Area (3hr AM Peak)													
Avg Mixed Flow Speed	46.0	48.0	48.7	44.3	46.5	41.9	46.7	38.8	46.2	36.8	46.0	34.7	46.5
Avg HOV Speed	51.5	51.9	52.9	48.3	50.5	46.1	51.0	42.8	50.7	41.7	51.0	39.3	51.1
Avg Arterial speed	29.0	29.1	29.2	28.0	29.0	27.3	28.8	26.3	28.5	25.5	28.3	24.4	28.1
Avg Speed (All Facilities)	33.3	33.9	34.1	32.3	33.4	31.1	33.2	29.6	32.8	28.6	32.6	27.4	32.6

Numbers may not add due to rounding

	2000 Base Year	2005 Baseline	2005 Plan	2010 Baseline	2010 Plan	2015 Baseline	2015 Plan	2020 Baseline	2020 Plan	2025 Baseline	2025 Plan	2030 Baseline	2030 Plan
Vehicle Miles Traveled (VMT)													
Light and Medium Duty Vehicles	337,528,000	350,967,000	346,401,000	383,440,000	369,460,000	401,446,000	383,505,000	419,161,000	399,283,000	433,216,000	418,777,000	449,685,000	431,863,000
Heavy Duty Trucks	23,937,000	26,045,000	26,043,000	28,955,000	28,961,000	31,382,000	31,778,000	34,489,000	34,705,000	36,516,000	37,776,000	39,072,000	40,784,000
All Vehicles and trucks	361,465,000	377,012,000	372,444,000	412,395,000	398,421,000	432,828,000	415,283,000	453,650,000	433,988,000	469,732,000	456,553,000	488,757,000	472,647,000
Vehicle Hours Traveled (VHT)													
Light and Medium Duty Vehicles	9,549,000	9,811,000	9,662,000	11,063,000	10,407,000	11,858,000	10,872,000	12,759,000	11,447,000	13,466,000	12,105,000	14,374,000	12,470,000
Heavy Duty Trucks	553,000	591,000	588,000	676,000	661,000	746,000	727,000	839,000	800,000	901,000	875,000	986,000	940,000
All Vehicles and trucks	10,102,000	10,402,000	10,250,000	11,739,000	11,069,000	12,604,000	11,599,000	13,599,000	12,247,000	14,366,000	12,980,000	15,359,000	13,410,000
Vehicle Hours Delayed													
Light and Medium Duty Vehicles	1,452,000	1,424,000	1,361,000	1,872,000	1,561,000	2,203,000	1,647,000	2,633,000	1,790,000	2,973,000	1,957,000	3,447,000	2,007,000
Heavy Duty Trucks	89,000	91,000	88,000	120,000	106,000	145,000	120,000	179,000	139,000	204,000	158,000	242,000	165,000
All Vehicles and trucks	1,541,000	1,515,000	1,449,000	1,992,000	1,667,000	2,348,000	1,767,000	2,811,000	1,929,000	3,177,000	2,114,000	3,689,000	2,171,000

Numbers may not add due to rounding